REMARKS

This is intended as a full and complete response to the Office Action dated October 10, 2006, having a shortened statutory period for response set to expire on January 10, 2007. Please reconsider the claims pending in the application for reasons discussed below.

A copy of the initialed and dated declaration is attached herewith. The declaration is now believed to be compliant per 37 C.F.R. 1.52(c).

The drawings stand objected to by the Examiner for failing to comply with 37 C.F.R. § 1.84(p)(5). The Examiner asserts that the drawings do not include "chamber lid 132" as described in paragraph [0038] of the specification. The Applicant respectfully traverses the objection.

The preliminary amendment filed by the Applicant and entered by the Office on January 18, 2006 contains Figure 2, on the Replacement Sheet 2, having the chamber lid labeled with reference element 132.

Withdrawal of the objection is respectfully requested by the Applicant.

The specification stands objected to by the Examiner for having reference elements 164, 170, and 172, in Figure 2, but not defined in the disclosure. The Applicant respectfully traverses the objection.

Reference element 164 was in the originally filed specification, for example, "reaction zone 164" is disclosed four times in paragraph [0070].

Reference element 170 was removed from Figure 2, on the Replacement Sheet 2, by the preliminary amendment filed by the Applicant and entered by the Office on January 18, 2006.

Reference element 172 was added into the specification as "cap 172" in paragraph [0044] by the preliminary amendment filed by the Applicant and entered by the Office on January 18, 2006.

Withdrawal of the objection is respectfully requested by the Applicant.

The specification stands objected to under 35 U.S.C. 132(a) for introducing new matter into the disclosure. The Examiner asserts that the added material of the amendment filed January 18, 2006 is not supported by the original disclosure. The Applicant respectfully traverses the objection.

The material added to the specification during the preliminary amendment filed January 18, 2006 is supported by the incorporation by reference, which was specific to further detailed description for chamber 80. The first two sentences of paragraph [0031] ***as filed*** specifically cites:

> Figure 2 is a schematic cross-sectional view of one embodiment of a chamber 80 including a gas delivery apparatus 130 adapted for cyclic deposition, such as atomic layer deposition or rapid chemical vapor deposition. A detailed description for a chamber 80 is described in commonly assigned U.S. Patent Application Publication No. 20030079686 and commonly assigned U.S. Patent Application Serial No. 10/281,079, entitled "Gas Delivery Apparatus for Atomic Layer Deposition", filed October 25, 2002, which are both incorporated herein in their entirety by reference.

During the preliminary amendment filed January 18, 2006, the second sentence of paragraph [0031] was amended to cite:

> A detailed description for a chamber 80 is described in commonly assigned U.S. ~~Patent Application~~ Publication No. 20030079686, and issued as U.S. Patent No. 6,916,398, and commonly assigned and co-pending U.S. ~~Patent Application~~ Serial No. 10/281,079, entitled "Gas Delivery Apparatus for Atomic Layer Deposition," [[,]] filed October 25, 2002, and published as US 20030121608, which are both incorporated herein ~~in their entirety~~ by reference in their entirety.

The amendment updated the status of U.S. Pub. No. 2003-0079686 as U.S. Pat. No. 6,916,398, as well as updated the status of U.S. Ser. No. 10/281,079 as U.S. Pub. No. 2003-0121608. In the remarks section of the preliminary amendment filed January 18, 2006, the Applicant stated:

> Paragraph 36 of the specification has been amended to include disclosure from U.S. Patent No. 6,916,398, which is incorporated by reference within the present application. Support for the amendment may be found in the '398 patent between column 6, line 63 and column 7, line 18.

Further support for the amendment may be found in U.S. Pub. No. 2003-0079686 (which was originally incorporated by reference) between paragraphs [0043]-[0045]. Also, additional support for the amendment may be found in U.S. Ser. No. 10/281,079 (which was originally incorporated by reference) between paragraphs [0071]-[0074].

Withdrawal of the objection is respectfully requested by the Applicant.

Claims 1-2, 4-5, 7-11, 13-14, 16-18, 20-22, 24, 27-31, 33-37, and 53-75 remain pending in the application upon entry of this Response. Claims 1-2, 4-5, 7-11, 13-14, 16-18, 20-22, 24, 27-31, 33-37, and 53-75 stand rejected by the Examiner. Reconsideration of the rejected claims is requested for reasons presented below.

Claims 14, 16-18, 20-22, 24, 54-61, and 63-75 stand rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. Also, claims 14, 16-18, 20-22, 24, 54-61, and 63-75 stand rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement. The Examiner asserts that the disclosure does not contain information on a carrier gas having a circular flow pattern, nor does it enable one of ordinary skill in the art to create a carrier gas with a circular flow pattern, and that one of ordinary skill in the art would not recognize what is meant by a circular flow pattern or recognize its novelty or importance because of lack of description. The Applicant respectfully traverses both of these rejections.

Paragraph [0031] of the originally filed specification states that chamber 80, including gas delivery apparatus 130 (as depicted in Figure 2), is adapted for cyclic deposition, such as atomic layer deposition, and then states that a "detailed description for a chamber 80 is described in" the '686 publication and the '079 application, "which are both incorporated in their entirety by reference." Paragraph [0031] further states

that the term "ALD" refers to "the sequential introduction of reactants to deposit a thin layer over a substrate structure."

The chamber 80 in Figure 2 of the present application corresponds to the chamber 200 in Figure 1 of the '686 publication (as well as the chamber 200 in Figure 1 of the '079 application). Figures 2-4 of the '686 publication along with the corresponding description from paragraphs [0039] to [0051], clearly describe how the chamber 200 is used to form circular flow patterns. For example, in paragraph [0004], "the circular flow 310 (FIG. 3) may travel as a "vortex," "helix," or "spiral" flow 402A, 402B through the expanding channel 234 as shown by arrows 402A, 402B." Similar figures and description are also disclosed in the '079 application. (See U.S. Pub. No. 2003-0121608, Figures 1, 8, and 11-12, and paragraphs [0070] – [0082]).

Also, paragraph [0036] of the originally filed specification states that chamber 80 "permit[s] the process gas and/or purge gas to enter the chamber 80 normal (*i.e.,* 90°) with respect to the plane of the substrate 90 via the gas delivery apparatus 130. Therefore, the surface of substrate 90 is symmetrically exposed to gases that allow uniform film formation on the substrates." To paragraph [0036], further clarifying description of the gas flow was added to the specification during the preliminary amendment as discussed above.

Further, paragraph [0053] of the originally filed specification describes process sequence 100 (Figure 3) having step 102 for adjusting the process conditions including chamber pressure and gas flow rates within the process chamber. Paragraphs [0054]-[0060] of the originally filed specification further disclose one embodiment in which a constant carrier gas flow is established and precursors are pulsed into the carrier gas stream. Paragraph [0070] provides an example of the ALD process being conducted in process chamber 80 of Figure 2.

One of ordinary skill in the art is enabled to create a carrier gas with a circular flow pattern, and would also recognize what is meant by a circular flow pattern or recognize its novelty or importance.

In view of the Applicant's remarks above and in view of the claim amendments, the Applicant asserts that the pending claims comply with the written description

requirement and comply with the enablement requirement under 35 U.S.C. § 112, first paragraph.

Withdrawal of the rejections is respectfully requested by the Applicant.

Claims 1-2, 4, 7-10, 27-30, and 33-36 stand rejected under 35 U.S.C. § 102(e) as being anticipated by *Kim*, U.S. Pub. No. 2002-0173054 (herein *Kim*). The Examiner asserts that *Kim* discloses all of the above claimed elements. The Applicant respectfully traverses the rejection.

Kim discloses a process for fabricating a ruthenium film by using an ALD technique. *Kim* discloses ruthenium precursors having the chemical formula RuX_2 or RuX_3 where "***X is a material*** selected from the group consisting of H, C_1~C_{10} alkyl, C_2~C_{10} alkenyl, C_1~C_8 alkoxy, C_6~C_{12} aryl, β-diketonates, cyclopentadienyl, C_1~C_8 alkylcyclopentadienyl and derivatives thereof including halogens." (***emphasis added*** – paragraph [0020]). *Kim* teaches that RuX_2 or RuX_3 reacts with hydrazine (between paragraphs [0019]-[0020]) or dimethylhydrazine ([0029]-[0030]) to respectively form 2HX or 3HX. These stoichiometric reactions taught by *Kim* suggest that in either RuX_2 or RuX_3, all anionic ligands X are the same ligands, i.e., *Kim* does not disclose a ruthenium precursor having more than one type of ligand. *Kim* states throughout the specification that "X is a material" and suggest that each X is an independent material. This is further evident since *Kim* teaches forming RuX_3 from 3 equivalents of the precursor HX and forming RuX_2 from 2 equivalents of the precursor HX. (paragraphs [0007]-[0008]). Therefore, *Kim* does not anticipate ruthenium precursors containing two or more different ligands attached to ruthenium.

Also, the Examiner states that *Kim* discloses that "the ruthenium precursor has C1-C8 alkylcyclopentadienyl ligands" and therefore "meets all recitations of claim 1 at least as broadly recited by claim 1." (Current OA, page 5). The Applicant respectively disagrees with the Examiner. As discussed above, the ligands of RuX_2 and RuX_3 may not differ within the ruthenium precursor, since *Kim* lacks such disclosure. Therefore, *Kim* does not anticipate ruthenium precursors containing only one alkylcyclopentadienyl ligand. Also, *Kim* does not anticipate ruthenium precursors containing 2,4-dimethylpentadienyl ligands. Further, independent claims 1 and 27 of the present

application do not recite ruthenium precursors having two or three alkylcyclopentadienyl ligands as taught by *Kim*.

Therefore, *Kim*, does not teach, show, or suggest a method for forming a ruthenium layer on a substrate, comprising positioning a substrate within a process chamber, and exposing the substrate sequentially to a ruthenium-containing compound and a reducing gas during an atomic layer deposition process to form a ruthenium material on the substrate, wherein the ruthenium-containing compound is selected from the group consisting of bis(2,4-dimethylpentadienyl) ruthenium, (2,4-dimethylpentadienyl) ruthenium (cyclopentadienyl), (2,4-dimethylpentadienyl) ruthenium (methylcyclopentadienyl), (2,4-dimethylpentadienyl) ruthenium (ethylcyclopentadienyl), (2,4-dimethylpentadienyl) ruthenium (isopropylcyclopentadienyl), derivatives thereof, and combinations thereof, as recited in claim 1, and claims dependent thereon.

Also, *Kim*, does not teach, show, or suggest a method for forming a layer comprising ruthenium on a substrate within a process chamber, comprising a) exposing a substrate to a ruthenium-containing compound to form a ruthenium-containing layer thereon, wherein the ruthenium-containing compound contains a 2,4-dimethylpentadienyl ligand, b) purging the process chamber with a purge gas, c) exposing the substrate to a reducing gas to form a ruthenium-containing layer material thereon, and d) purging the process chamber with the purge gas, as recited in claim 27, and claims dependent thereon.

Withdrawal of the rejection is respectfully requested by the Applicant.

Claims 5, 13, 31, 53, and 62 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Kim* in view of *DelaRosa et al.*, U.S. Pat. No. 6,527,855 (herein *DelaRosa*). The Examiner asserts it would have been obvious for one skilled in the art to modify *Kim* with the disclosure of *DelaRosa*. The Applicant respectfully traverses the rejection.

The Examiner further asserts that *Kim* "includes all the provisions of claims 5 and 31 (substrate temperature paragraph 0025) except providing a pressure below 80 torr." (Current OA, page 7). The Applicant respectively disagrees to the Examiner's assertion. Claim 5 depends from claim 4 which cites that the reducing gas comprises one or more specific reducing agents. Similarly, claim 31 depends from claim 30. The

Examiner rejected claim 4 since "Kim discloses the reducing gas as hydrogen in paragraph 0036 line 1." (Current OA, page 6). However, *Kim* states "hydrogen and oxygen ***can be used*** as a reaction gas. H_2 ***has to be*** decomposed at 600° C. or higher into 2H in order to deposit an atomic layer." ([0036] – ***emphasis added***). *Kim* further states "in case of using hydrogen, which is a reducing gas, as a reaction gas, because a deposition temperature ***has to be*** set at over 600° C. in order to activate the hydrogen." ([0010] – ***emphasis added***). The Federal Circuit has mandated that "[a] prior art reference is relevant for ***all that it teaches*** to those of ordinary skill in the art." (*In re Fritch*, 23 U.S.P.Q.2d 1780, 1782 (1992) – ***emphasis added***). It follows that it is unfair to take *Kim*'s disclosure of hydrogen in isolation from *Kim*'s teaching that when used, hydrogen "has to be decomposed at 600° C. or higher." *Kim* also discloses oxygen, hydrazine, and dimethylhydrazine as other reducing agents. However, claim 4 of the present application is not anticipated by any of these reagents.

The Examiner states that *DelaRosa* "discloses the chamber pressure to range from 0.1 to 10 torr (column 3 lines 52-54) in order to affect the pulse length of gases in a desirable manner (column 3 lines 39-42)." (Current OA, page 7).

However, *DelaRosa* further discloses that "[s]ome factors affecting pulse length include reactor pressure, ***substrate temperature***, reaction rate, and ***reactivity of the precursor, reducing agent***." (column 3, lines 37-41 – ***emphasis added***). Also, *DelaRosa* discloses that "deposition temperature typically ***depends on the precursor and reducing agent used***. Temperature of the substrate may be high enough to allow adsorption of the precursor species, ***but low enough to prevent thermal decomposition***. Temperatures typically used range from about 200° C. to about 400° C." (column 3, lines 47-51 – ***emphasis added***).

The Examiner has not provided evidence for why one skilled in the art would be motivated to modify *Kim*, which teaches that the reducing agent, hydrogen, "has to be decomposed at 600° C. or higher," with that taught by *DelaRosa* which teaches that the deposition temperature must be "low enough to prevent thermal decomposition" and "typically used range from about 200° C. to about 400° C."

Therefore, *Kim* and *DelaRosa*, alone or in combination, do not teach, show, or suggest a method for forming a ruthenium layer on a substrate, comprising positioning a

substrate within a process chamber, and exposing the substrate sequentially to a ruthenium-containing compound and a reducing gas during an atomic layer deposition process to form a ruthenium material on the substrate, wherein the ruthenium-containing compound is selected from the group consisting of bis(2,4-dimethylpentadienyl) ruthenium, (2,4-dimethylpentadienyl) ruthenium (cyclopentadienyl), (2,4-dimethylpentadienyl) ruthenium (methylcyclopentadienyl), (2,4-dimethylpentadienyl) ruthenium (ethylcyclopentadienyl), (2,4-dimethylpentadienyl) ruthenium (isopropylcyclopentadienyl), derivatives thereof, and combinations thereof, as recited in claim 1, and claims 5, 13, and 53 dependent thereon.

Also, *Kim* and *DelaRosa*, alone or in combination, do not teach, show, or suggest a method for forming a layer comprising ruthenium on a substrate within a process chamber, comprising a) exposing a substrate to a ruthenium-containing compound to form a ruthenium-containing layer thereon, wherein the ruthenium-containing compound contains a 2,4-dimethylpentadienyl ligand, b) purging the process chamber with a purge gas, c) exposing the substrate to a reducing gas to form a ruthenium-containing layer material thereon, and d) purging the process chamber with the purge gas, as recited in claim 27, and claims 31 and 62 dependent thereon.

Withdrawal of the rejection is respectfully requested by the Applicant.

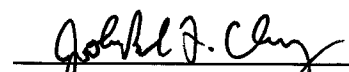
Claims 1, 2, 14, 16, and 27-29 stand provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-4, 11, 27-30, and 36-40 of co-pending U.S. Ser. No. 10/811,230.

A terminal disclaimer compliant with 37 C.F.R. 1.321(c) is attached along with this Response. Accordingly, the Applicant respectively requests withdrawal of these rejections.

In conclusion, the references cited by the Examiner, alone or in combination, do not teach, show, or suggest the claimed invention.

Having addressed all issues set out in the Office Action, the Applicant respectfully submits that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,



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